# THE WEATHER AND CIRCULATION OF MAY 1968

## Cool Weather With Widespread Blocking

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### 1. SEVERE WEATHER

Tornadoes struck in 17 states during the week ending May 19. Before this week tornadoes and thunderstorms with hail and damaging winds were scattered throughout Texas and as far north as Nebraska. But the most violent weather of the month came on May 15 when residents of seven states reported more than 50 tornadoes. In Arkansas 48 persons died in tornadoes with hundreds injured. Others died in Iowa (12), Missouri, Illinois, and Indiana. By midweek severe weather had spread from Texas to the Great Lakes and eastward to the Appalachians. After this terrible week of destruction a number of tornadoes occurred but the violence lessened. Injuries and damage decreased as many storms avoided populous areas.

### 2. MEAN 700-MB. CIRCULATION

Blocking dominated the circulation over an extremely large area this month (fig. 1 and 2) with a belt of above normal 700-mb. heights from the Sea of Okhotsk to

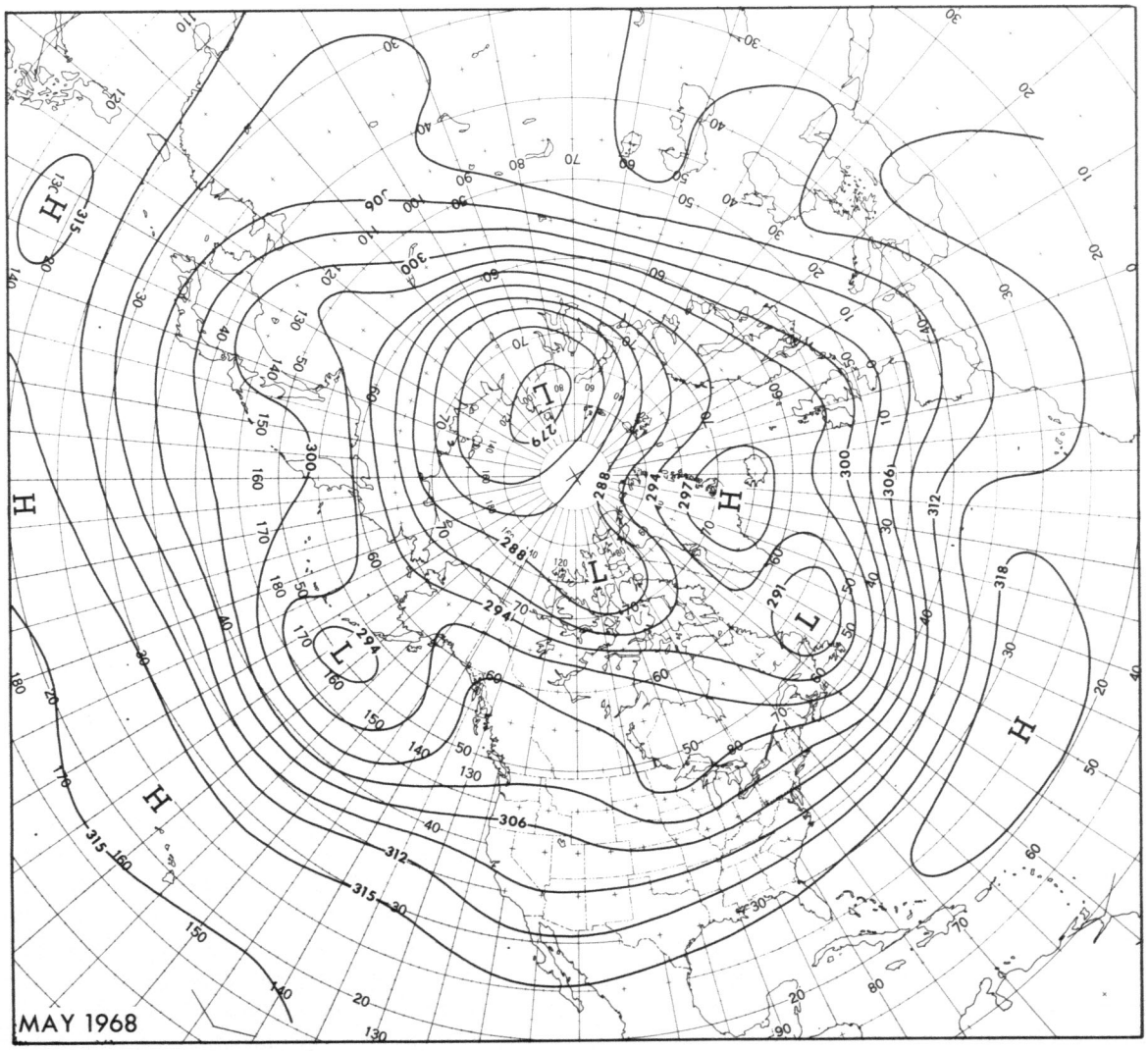



FIGURE 1.—Mean 700-mb. contours (decameters) for May 1968.

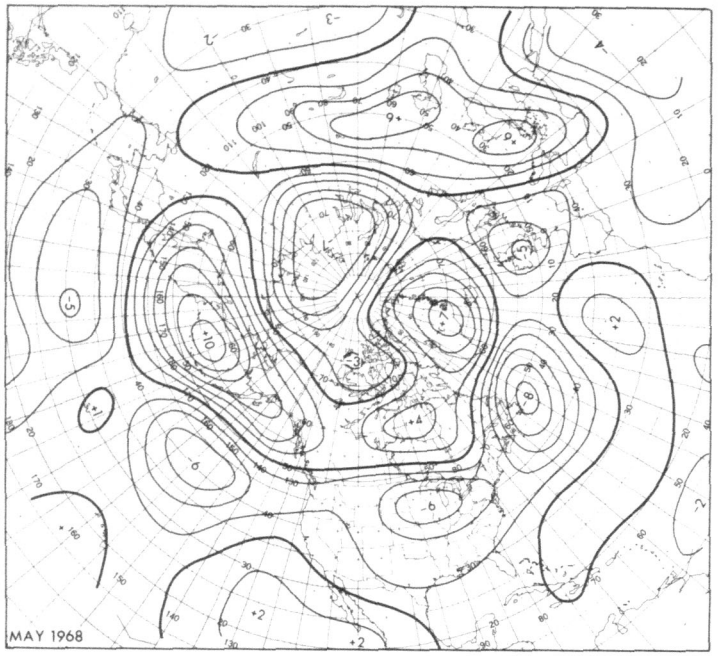



FIGURE 2.—Departure from normal of mean 700-mb. height (decameters) for May 1968.

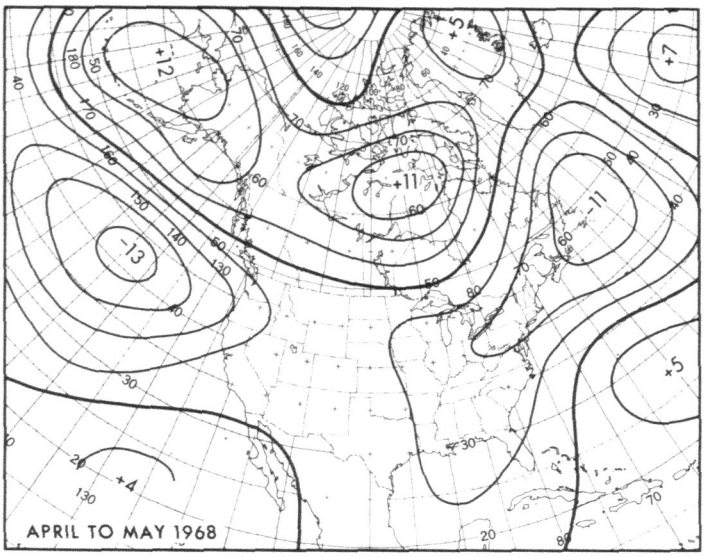



FIGURE 3.—Mean 700-mb. height anomaly change (decameters) from April to May 1968.

Hudson Bay, then to Greenland. Anomalous heights were negative in midlatitudes from the coast of Asia eastward to the North Sea. In the western portion of the Northern Hemisphere the westerlies shifted from an average latitude of 43°N. in April to 38°N. in May. The 700-mb. zonal index of temperate westerly flow from 0°–180° and from 35°–55°N. also reacted to blocking. In April the index was 8.9 m.p.s. but as the westerlies moved southward and weakened in the northerly portion of the zone, the index fell to 6.1 m.p.s., a decrease of 2.0 m.p.s. relative to normal.

An index cycle accompained blocking this month. These parallel features resulted in cool air much farther south than normal, in and near the broad, cold trough in the United States; warm weather in higher latitudes was associated with above normal heights. This month-long index cycle began with a high value of the westerly index of 9.5 m.p.s. (1.8 m.p.s. above normal) for the 5-day period ending April 29, decreased to 4.2 m.p.s. (3.0 m.p.s. below normal) during May 11–15, and increased to a normal value of 7.1 m.p.s. by May 23–27.

Great changes in the 700-mb. circulation show on the height anomaly change chart from April to May (fig. 3). Blocking in the Atlantic and eastern North America of last month strengthened this month in the Atlantic as heights fell 110 m. near Newfoundland. The Low here replaced the flat westerly flow of April [1] when heights were 40 m. above normal. As blocking proceeded in the Atlantic, monthly mean 700-mb. heights increased to a maximum of 70 m. above normal over Greenland and 40 m. above normal over Hudson Bay (fig. 2).

In the eastern Atlantic where blocking was most pronounced in April, a ridge in May replaced the trough formerly there and heights increased 70 m. This ridge was rather weak (fig. 2) and although apparently aligned with the High near Greenland, the 700-mb. height anomaly showed a negative channel, suggesting a storm track, from Newfoundland to the United Kingdom.

Over Europe the trough was only 40 m. deeper than normal, quite persistent, and was responsible for cool weather over western Europe this May. Storms from the western Atlantic intensified in the eastern Atlantic and were followed by cold outbreaks that occasionally reached the Mediterranean coast.

Asia was affected mostly by a large, strong Polar vortex. Flow around this Low combined with the strong southwesterly flow from the European trough produced confluent flow in high latitudes with the westerlies about 6 m.p.s. faster than normal. From the central Mediterranean to Lake Baikal thickness and 700-mb. heights were above normal, both of which suggest unseasonable warmth.

Anticyclogenesis was very strong over the Bering Sea this month. During April a 700-mb. Low in this area with a trough to the south accounted for heights being 60 m. below normal, but the ensuing evolution made heights in May about 100 m. above normal as ridging took place. As blocking became established in the Pacific height increases spread eastward in high latitudes to North America. This is shown in the height anomaly change chart (fig. 3) as a band of height increases that extended from the Bering Sea to a center 110 m. above normal in northeastern Canada. In lower latitudes in the Pacific anomalous heights fell 130 m. from April to May associated with the blocking as the ridge of April in the eastern Pacific was replaced by cyclonic curvature associated with a Low near the eastern Aleutians.

Changes in the circulation over and near the United States resulted from the strong height increases in

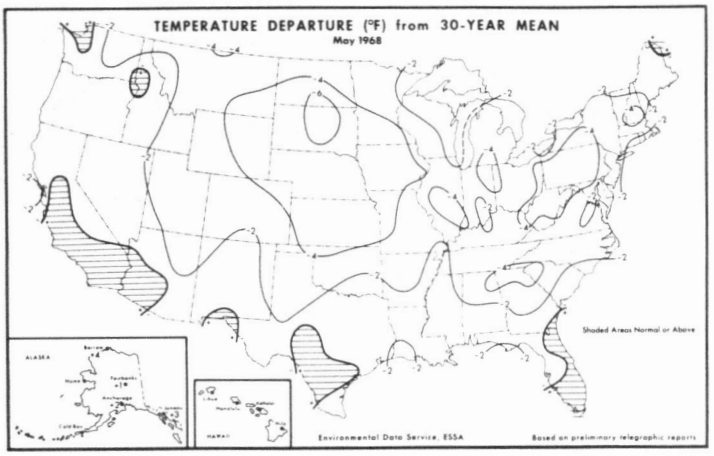



FIGURE 4.—Departure from normal of average surface temperature (°F.) for May 1968 (from [3]).

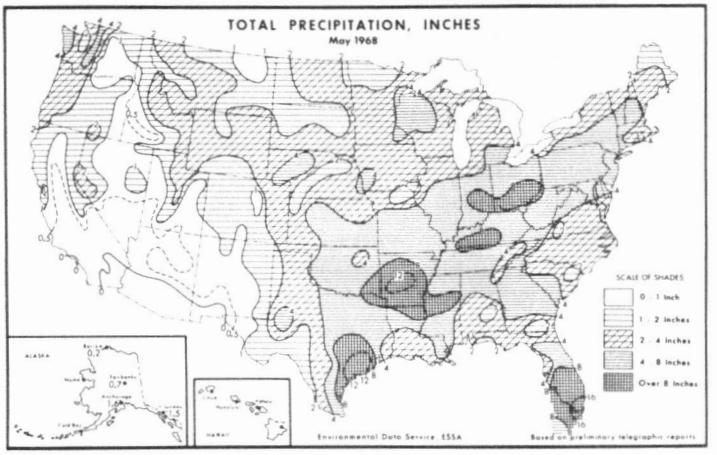



FIGURE 5.—Total precipitation (in.) for May 1968 (from [3]).

Canada. Westerly flow was split off the west coast with the lower path of the westerlies over the United States and the upper branch across northern Canada, typical of blocking. Cyclonic and westerly flow dominated the Nation except in the Pacific Northwest where a ridge appeared. Over the conterminous United States, 700-mb. heights were below normal.

## 3. MONTHLY WEATHER

### TEMPERATURE

Temperatures averaged below normal over the Nation this month (fig. 4), influenced to a large extent by the blocking circulation. Flow at 700 mb. was predominantly westerly but heights averaged below normal, mostly in response to above normal heights in Canada. This type of flow encouraged occasional outbreaks of cold air from northern Canada that followed paths (see chart VIII of [2]) farther east than in colder seasons when the source region is northwest Canada. Flow from the Pacific also helped produce lower than normal temperatures as cool, maritime air was transported into the country. Over most of the United States temperatures were only 2°–4°F. lower than normal with little significant variability except for brief warmth in the West early and late in the month.

Daily minimum temperature records were established in about one-third of the States, a few in the West but most in the East, but no monthly mean records appeared. Below freezing temperatures resulted in the coldest weather so late in the spring at Rapid City, S. Dak. (May 20), Medford, Oreg. (May 6), and Grand Junction, Colo. (May 7).

Temperature anomaly change from April to May showed some warming in the West as most stations changed from Much Below to Below or from Below to Normal. In the eastern two-thirds of the Nation temperatures lowered where anticyclonic flow and above normal heights in April were replaced by cyclonic flow and below normal heights in May. Out of 100 stations across the United States 59 percent cooled and 27 percent warmed.

### PRECIPITATION

Substantial rainfall this month relieved marginal crop moisture conditions in some areas and created an excessive moisture problem over portions of the eastern half of the Nation.

More than 4 in. of rain fell from the Texas coast through the Ohio Valley to southern New England (fig. 5), but 8 in. to more than 12 in. fell locally from Texas to Ohio, the cause of some flooding. Cincinnati, Ohio, reported a new May precipitation record of 10.22 in. (6.42 in. above normal), as did Columbus with 9.84 in. (6.38 in. above normal). In Florida near-drought was eliminated with 8 in. to more than 16 in. over the southern half of the state. Miami had 18.54 in. (12.10 above normal), and Ft. Myers had 10.32 in. (6.42 in. above normal).

Precipitation was about normal over much of the West although amounts were generally 1–2 in. Less than an inch fell over most of the Great Basin and the southern Plateau. Snow fell as late as the third week of May this year but amounts were only 2–3 in. over the Rockies. Huron, S. Dak., had snow on the 18th, the latest date in spring for measurable snowfall.

Heavy rain, hail, and severe weather in the Central and Southern Plains seemed better related to 5-day mean or daily troughs than to the monthly mean. However, below normal monthly mean 700-mb. heights and lower than normal monthly thickness are generally correlated with widespread heavy precipitation and storminess in the warmer months. Repeated cooling in central United States provided an environment conducive to baroclinic activity and overrunning. Heavy precipitation from the lower Ohio Valley to southern New England was near the monthly mean 700-mb. wind maximum.

## 4. WEEKLY CIRCULATION AND WEATHER

### APRIL 29–MAY 5

Cyclonic curvature over most of the eastern Pacific, associated with a weak trough (fig. 6A), was accompanied by heights slightly below normal. The ridge over western

North America was quite weak, only 50 m. above normal. The eastern half of North America was influenced principally by blocking with a deep Low (140 m. below normal) over the Gulf of St. Lawrence and positive 700-mb. height anomalies from central Canada to the strong blocking High south of Greenland.

Temperatures this first week (fig. 6B) were generally above normal in the western two-thirds of the Nation, the first time in a month. The Southern Plains States and portions of the Pacific Coast States were a few degrees cooler than normal. The warmth in the West was related to the anticyclonic flow and above normal heights under which conditions major intrusions of cold air were deflected eastward. Maximum temperatures reached the 80's in the Great Plains with the 90's frequent in Kansas and Nebraska. By the weekend a wedge of very cold air spread over the eastern third of the Nation and brought freezing and lower temperatures to the upper Ohio Valley.

Precipitation (fig. 6C) was generally very light over most of the country except in the Southeast where about an inch fell, with occasional totals to 2 in. along a cold front that moved through as a weak Low traveled from the Central Plains to New England. Greater amounts were absent because the Gulf of Mexico moisture source was only temporarily available as the mean flow was northwesterly and the anomalous flow was northerly. Light showers fell over the western half of the Nation the last 2 days of the week with passage of the cold front.

### MAY 6–12

A strong Low developed in the east-central Pacific south of 50°N. (fig. 7A) associated with widespread blocking from the International Dateline to western North America. This circulation contributed to strong anticyclogenesis downstream. The ridge along the British Columbia coast was 140 m. above normal for the 5-day period ending May 11. The trough that had been near the west coast moved into the West and deepened. Meanwhile the 700-mb. flow changed to sothwesterly over the Central States with moderate ridging in the East. Blocking in eastern North America decreased as a large Low dominated eastern Canada. Heights near Baffin Island decreased about 170 m. from last week.

Temperatures for the week (fig. 7B) reacted to the ridging along the Canadian coast and were generally lower than normal with negative departures of 6°–9°F. over the northern and central portions of the Great Plains and northern and central Rocky Mountain States. Cold air early this week came from the Pacific; a second outbreak came from the Beaufort Sea late in the week and was accompanied by minimum temperatures in the 20's and 30's in the Northern Plains. The East averaged a few degrees below normal despite the mean flow which suggests above normal temperatures.

Precipitation (fig. 7C) was heavy from southern Texas to the Ohio Valley with amounts generally 2–4 in. but over 8 in. in southeastern Texas. The first front of the week caused less than an inch of rain in the Plains until the front became stationary in the Southern Plains where it caused heavy rain, severe weather, and strong winds over Texas, Oklahoma, Kansas, and Louisiana. In southern Florida heavy rain totaled 2–8 in.

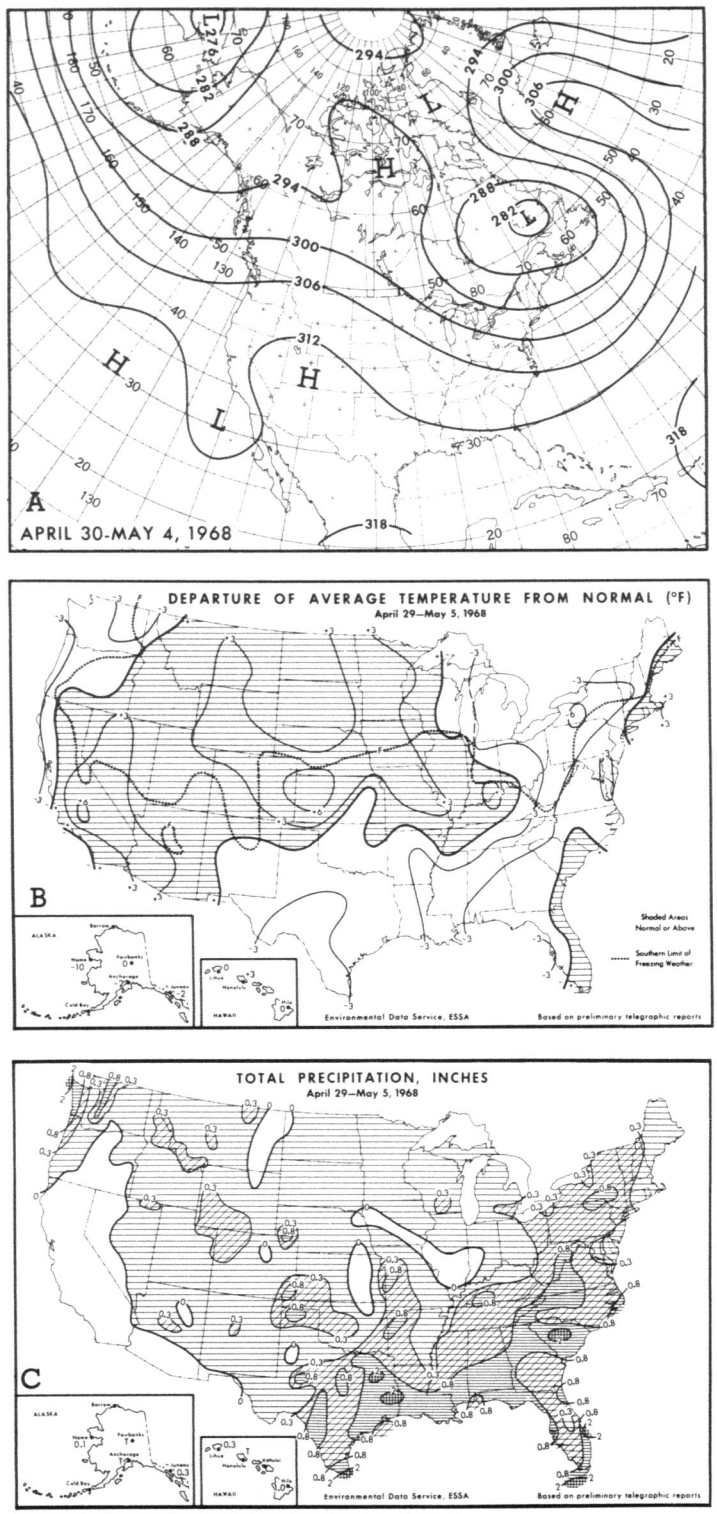
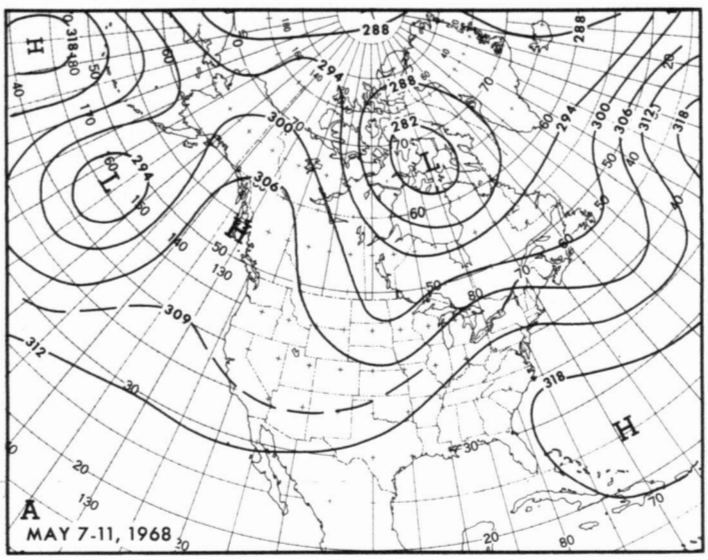
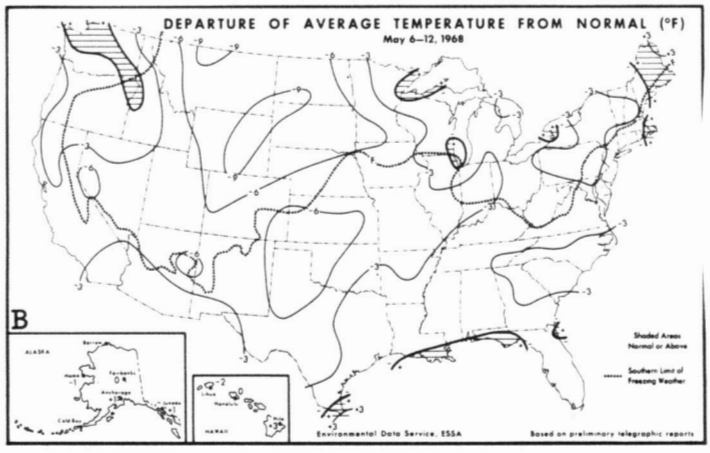



FIGURE 6.—(A) Mean 700-mb. contours (decameters) for Apr. 30–May 4, 1968; (B) departure from normal of average surface temperature (°F.) for Apr. 29–May 5, 1968 (from [3]); (C) total precipitation (in.) for Apr. 29–May 5, 1968 (from [3]).



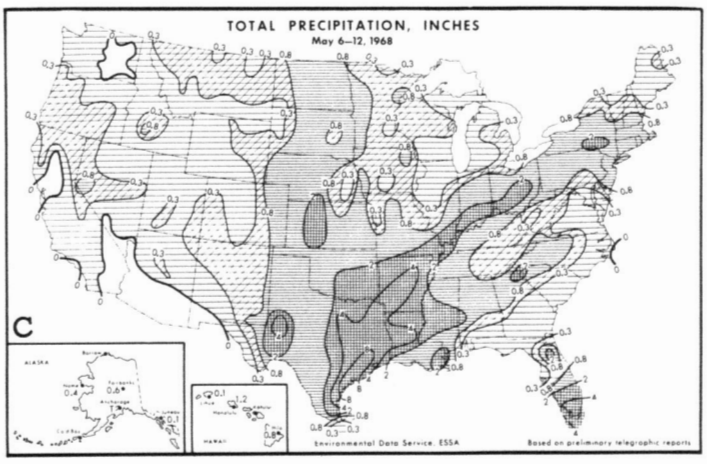
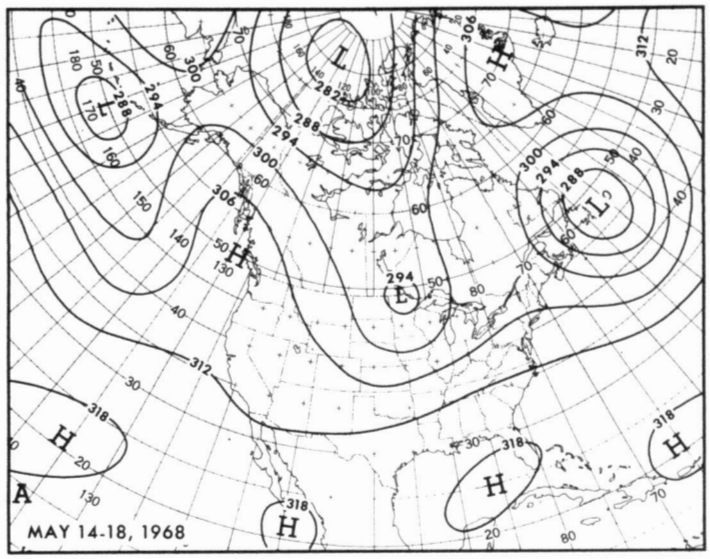
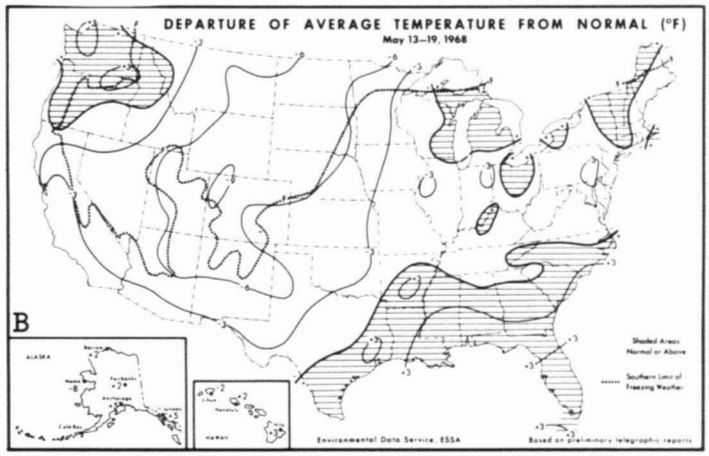




FIGURE 7.—Same as figure 6 except (A) for May 7–11, 1968; (B) and (C) for May 6–12, 1968 (both from [3]).



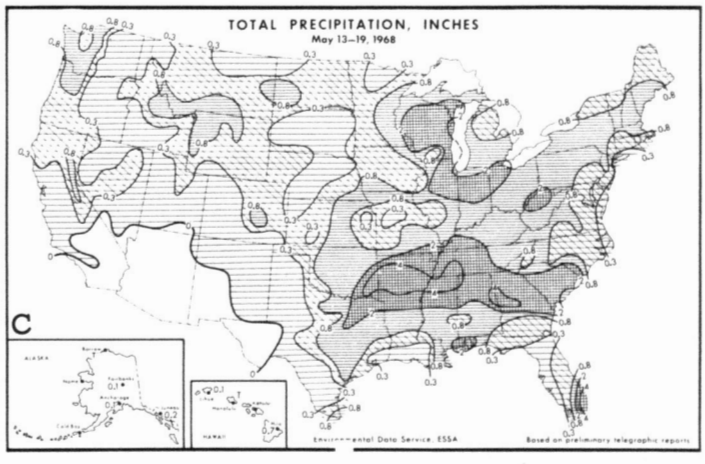
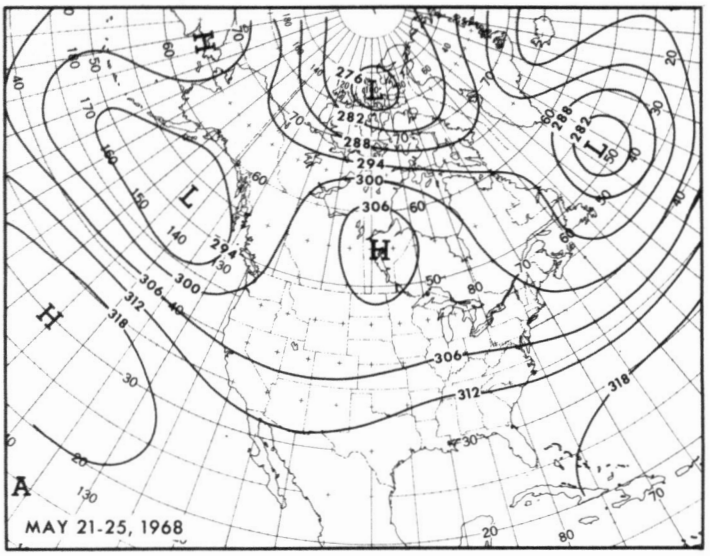
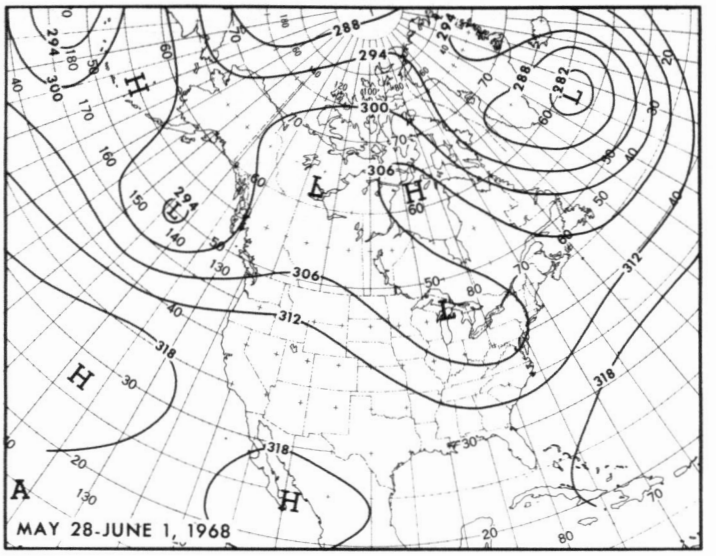



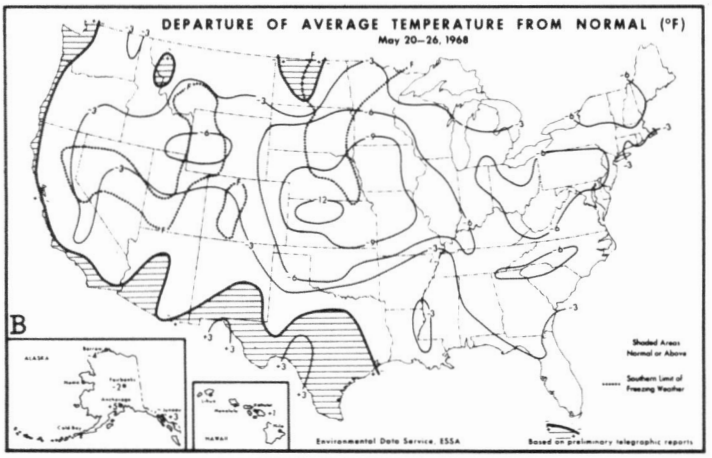

FIGURE 8.—Same as figure 6 except (A) for May 14–18, 1968; (B) and (C) for May 13–19, 1968 (both from [3]).

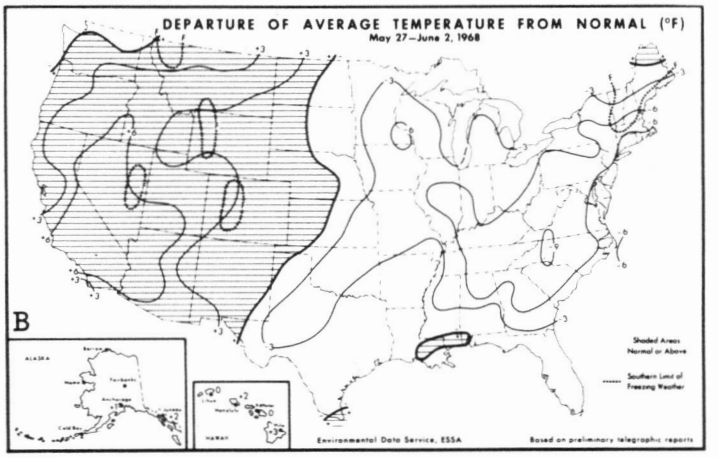
### MAY 13–19

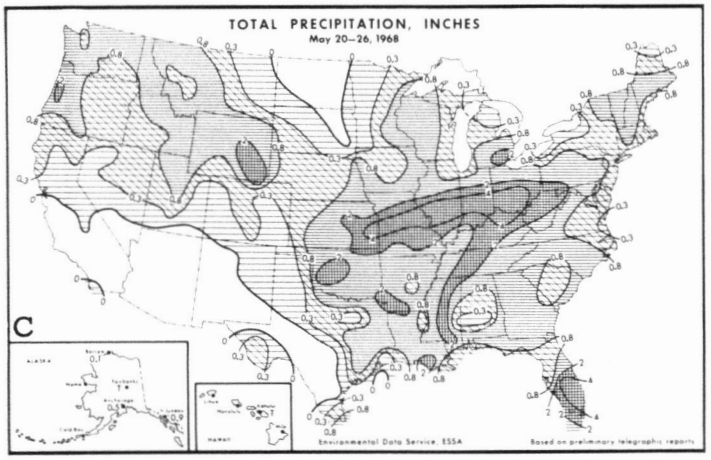
Blocking strengthened this week in the eastern North America—eastern Atlantic area (fig. 8A). Heights at 700-mb. increased to 180 m. above normal over Greenland and a deep Low (190 m. below normal) formed over Newfoundland. Also related to this blocking was the deepening trough in central North America. Principal daily contribution to the trough and Low in the United States was an upper level daily Low near the northern California coast early in the period that moved to the Lakes and became quasi-stationary near the mean Low. Tornado activity was widespread and very severe as indicated earlier with death, injury, and destruction very high.



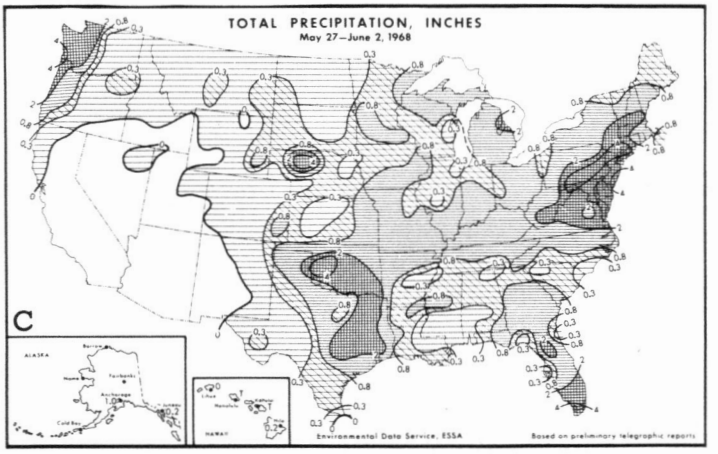




FIGURE 9.—Same as figure 6 except (A) for May 21–25, 1968; (B) and (C) for May 20–26, 1968 (both from [3]).

FIGURE 10.—Same as figure 6 except (A) for May 28–June 1, 1968; (B) and (C) for May 27–June 2, 1968 (both from [3]).

Some warming occurred this week (fig. 8B) but cool weather predominated. Temperatures were 3°–6°F. below normal over most of the western two-thirds of the Nation with 6°–9°F. below normal from the Dakotas to the Southwest. Freezing temperatures reached southern Nevada and the southern Rockies as a combination of cool maritime and cold Polar air followed the principal surface storm of the week. In portions of the Pacific Northwest and in a narrow band in the Southeast temperatures were 3°F. or more above normal.

Heaviest rain this week was in Arkansas (fig. 8C) where amounts were generally over 4 in., primarily from severe thunderstorms. In Florida rainfall was heavy again as the lower east coast received 2–4 in.

### MAY 20–26

Principal features of the 700-mb. flow (fig. 9A) progressed more this week than in earlier weeks but blocking still dominated the circulation and weather over North America. In the Pacific the Low moved into the Gulf of Alaska from the Aleutians. The ridge that was replaced moved rapidly into central Canada with a High near Lake Winnipeg. Consequently, westerly flow and the storm track were farther south than normal over the United States. The Low formerly over the Lakes weakened as heights there increased. Heights were much lower in the West and generally below normal over the rest of the Nation.

Border areas of the Southwestern States were a few degrees warmer than normal (fig. 9B) but most of the country was 3°–6°F. colder than normal. Persistent westerly flow in lower temperate latitudes prevented any appreciable southerly component of the flow or anticyclogenesis, either of which would have introduced warming.

Precipitation spread across the northern and central Rockies (fig. 9C) and was generally less than an inch with some snow in higher elevations of the central Rockies. From Kansas to western Maryland 2–4 in. of rain fell along a front that became nearly stationary Thursday and Friday. As the surface ridge and cold air pushed southward this front moved into the Southeast with light rain over most of the area. Southern Florida again had heavy rain with 4–6 in. in the southeast.

### MAY 27–JUNE 2

The 700-mb. circulation (fig. 10A) changed to a ridge in the West where a trough prevailed last week. This ridge strengthened as the Gulf of Alaska trough became oriented north-south instead of west-east. In the West 700-mb. heights increased as much as 90 m. over the Great Basin and the Plateau. The circulation also changed in the eastern half of the Nation. Here a trough replaced a flat ridge from the Lakes to Florida and a Low became established in the Lakes as blocking again characterized the circulation in eastern North America.

Surface temperatures (fig. 10B) responded to these height changes in a familiar manner. The West became warm relative to normal, a result of above normal heights and anticyclonic flow. Temperatures were 3°–6°F. above normal over much of this area with 6°–8°F. above normal common in the Great Basin. At Needles, Calif., the average daily maximum was 109°F. Temperatures were below normal from the Plains to the Atlantic coast with largest negative departures (9°F.) over western North Carolina. This coolness was associated with the trough that was as much as 80 m. below normal in the Ohio Valley. By the weekend warmth spread to the Great Plains.

The slow-moving daily trough spread heavy precipitation from east Texas to the Ohio Valley then to the Middle Atlantic States (fig. 10C). Heavy rainfall on already soaked ground caused flooding in southern Ohio and northern New Jersey. Southern Florida received heavy rain of 2 in. to more than 4 in.

### REFERENCES

1. J. F. Andrews, "The Weather and Circulation of April 1968—Cool in the West and Warm in the East," *Monthly Weather Review*, vol. 96, No. 7, July 1968, pp. 472–476.
2. Environmental Data Service, ESSA, *Climatological Data, National Summary*, vol. 19, No. 5, May 1968.
3. Environmental Data Service, ESSA, *Weekly Weather and Crop Bulletin*, vol. 55, No. 19–23, May 6, 13, 20, 27, and June 3, 1968, pp. 1–8.

☆U.S. GOVERNMENT PRINTING OFFICE : 1968—O-312-890